(12) UK Patent Application (19) GB (11) 2 220 083 (13) A

(43) Date of A publication 28.12.1989

(21) Application No 8913511.5

(22) Date of filing 13.06.1989

(30) Priority data
(31) 3820171 (32) 14.06.1988 (33) DE

(71) Applicant
Messerschmitt-Bölkow-Blohm GmbH

(Incorporated in the Federal Republic of Germany)

Robert-Koch-Strasse, 8012 Ottobrun,
Federal Republic of Germany

(72) Inventors
Peter Deimel
Gerhard Müller

(74) Agent and/or Address for Service
Barlow Gillett & Percival
Hollins Chambers, 64A Bridge Street, Manchester,
M3 3BA, United Kingdom

(51) INT CL[4]
G02B 6/42

(52) UK CL (Edition J)
G2J JGDB
H1K KQAG K1EB K5B1 K5H2L K5H2N K5R

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(58) Field of search
UK CL (Edition J) G2J JGDB JGEC JGED, H1K
KQAG
INT CL[4] G02B

(54) **Optical wave guide/detector combination**

(57) A detector in which a wave guide 2 directs optical radiation onto a light-sensitive surface 4 of the detector is arranged parallel to the wave guide 2 in such a way that the evanescent or transient part of the radiation conducted in the wave guide 2 is coupled directly into the detector. Preferably the detector includes a transparent electrode 3 which is dimensioned such as to protrude laterally beyond the detector film 4. A first metal contact 5 may be applied directly to the detector film 4 and a second metal contact 7 may be applied to the protruding region of the electrode 3.

Fig.2

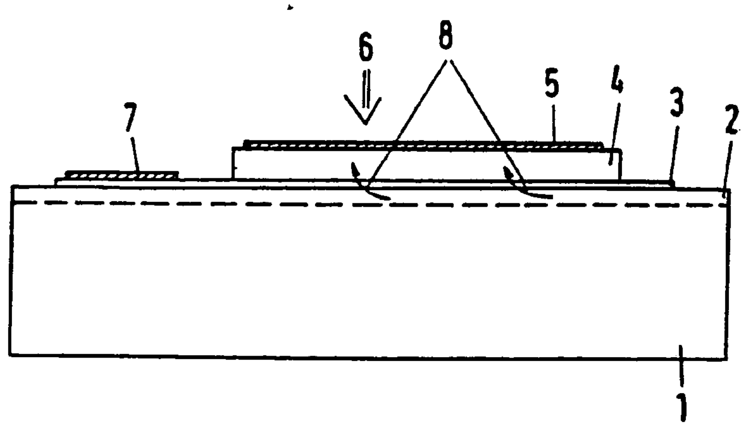

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Fig.1

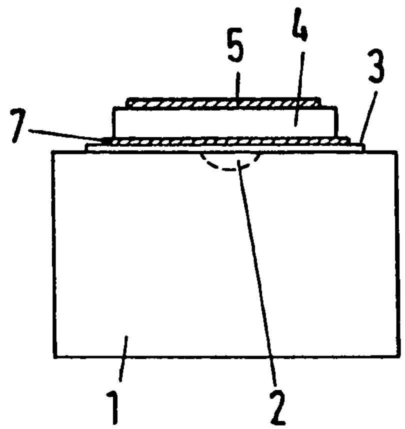
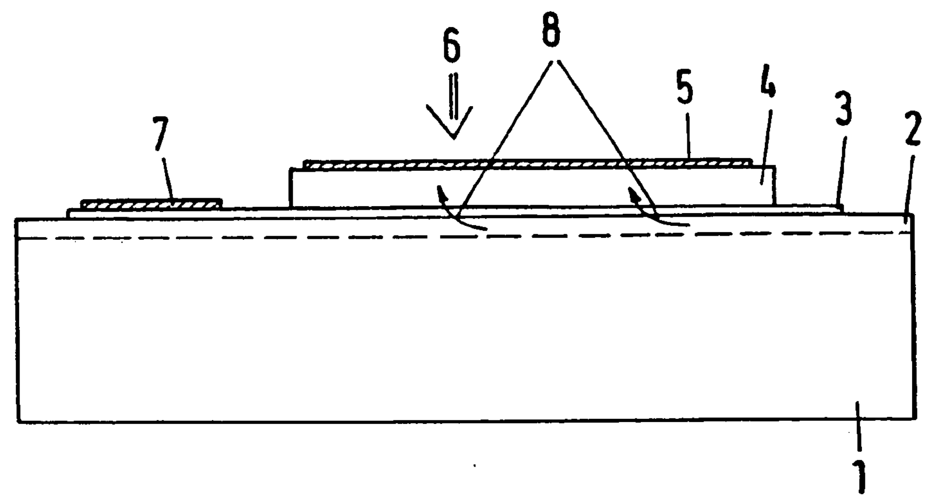


Fig.2



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A WAVE GUIDE/DETECTOR COMBINATION

The invention relates to a detector in which a wave guide directs optical radiation onto the detector's light-sensitive surface.

Conventionally the coupling of an optical fibre with a detector results in optical radiation striking the surface of the detector perpendicularly. In order to obtain optimum coupling, the fibre and the detector have to be adjusted precisely with respect to one another.

This known type of coupling has the disadvantage that the adjustments necessitate a comparatively high expenditure, and furthermore these known wave guide/detector combinations are not suitable for integration into a substrate. There has already been proposed in US Patent No. 4018506, a detector for optical radiation in which are provided on the one side a diffraction screen and on the other side a fibre coupled-up by means of an optical cement. However, this known arrangement has, the disadvantage that the production of the diffraction screen is expensive. In addition to this it is not simple to couple an optical fibre to a detector substrate at a specified angle with a pre-defined spacing by means of a cement.

The problem underlying the invention is to provide a detector which is coupled with a wave guide

and which with slight demands on production tolerances, adjusting expenditure and so forth is suitable for integration into a substrate.

In accordance with the invention a detector is arranged parallel to a wave guide in such a way that the evanescent or transient part of the radiation conducted in the wave guide is coupled into the detector. In other words, merely the exponentially decaying or decreasing part of the mode which "projects" beyond the wave guide into the detector is coupled into the detector. The optical power which can be decoupled from the wave guide is determined by the design and the dimensions of the detector.

This design, in which the detector and wave guide are arranged parallel, has the advantage that the demands on production tolerances and/or adjustment as compared with conventional combinations are considerably reduced.

A further advantage is that it is possible to integrate the detector and the wave guide into a substrate.

For example, the detector can be integrated above the wave guide and be defined by known photolithographic methods.

In this respect it is more especially advantageous if the detector is a thin-film detector applied to the substrate and which can consist, for example, of amorphous silicon, crystalline silicon or a

III-V-semiconductor. This detector can furthermore preferably be applied to the wave guide integrated into a glass substrate. In the case of a particularly advantageous refinement the thin-film detector has two electrodes which are parallel to the surface of the glass substrate, one of which electrodes is applied directly to the glass substrate and is transparent. In this way, in conjunction with the appropriately selected thickness of the electrode, a particularly large part of the evanescent radiation is coupled into the wave guide.

The transparent electrode preferably has dimensions which are, in at least one direction larger than the dimensions of the detector film and of the second electrode applied to the detector film, and in that the transparent electrode has a metal contact in that region which protrudes beyond the detector film.

The invention will be described in more detail hereinunder with the aid of an exemplified embodiment and with reference to the drawings, in which:

Fig. 1 shows a front view, and

Fig. 2 shows a side view of a substrate into which a wave guide/detector combination in accordance with the invention is integrated.

The wave guide/detector combination as shown in the figures has a substrate 1, which can for example be a glass substrate, and into which a wave guide 2 is integrated, e.g. by ion exchange in the substrate. Applied, for example by means of a thin-film technique,

to the wave guide 2 is an electrode 3 which is transparent for the light which is conducted by the wave guide 2. Applied to this electrode 3 is, in the case of the illustrated exemplified embodiment an amorphous silicon layer 4, which constitutes a detector film, and which has applied, thereto, a metal contact 5 acting as cathode. The transparent electrode 3 which is applied directly to the glass substrate 1 and which consists of, for example, ITO is in at least one direction larger than the detector film 4 applied to it, so that it "protrudes" laterally beyond this. Applied to the protruding part is a metal contact 7, which can be contacted with the transparent electrode 3 acting as anode. The layers 3, 4, 5 and 7 jointly form the detector 6.

As a result of this design, in which the wave guide 2 and the detector 6 are arranged in parallel, the evanescent part 8 of the radiation conducted in the wave guide 2 is coupled into the detector 6. In other words, merely the exponentially decaying or decreasing part of the mode which projects beyond the wave guide into the detector is coupled into the detector. The optical power which can be decoupled from the wave guide is determined by the design and the dimensions of the detector.

The presently proposed principle of the "lateral coupling" between wave guide 2 and detector 6 can be used for the most varied wave guide/detector

combinations. With the aid of this principle, optical sources, modulators, detectors and wave guides can be integrated together on a substrate. In each case the principle in accordance with the invention has the advantage that all of the electrodes are accessible from the same side. This simplifies not only the production, but also allows the integration of further components. Since the detector is applied to an electrically insulating layer, namely a glass substrate, the various components can be operated electrically independently of one another.

CLAIMS

1. A detector in which a wave guide directs optical radiation onto a light-sensitive surface of the detector, characterised in that the detector is arranged parallel to the wave guide in such a way that the evanescent part of the radiation conducted in the wave guide is coupled into the detector.

2. A detector as claimed in claim 1, characterised in that the detector and the wave guide are integrated into a substrate.

3. A detector as claimed in claim 2, characterised in that the detector is a thin-film detector which is applied to the substrate into which the wave guide is integrated.

4. A detector as claimed in claim 3, characterised in that the thin-film detector has two electrodes which are parallel to the substrate surface, one of which electrodes is applied directly to the substrate surface and is transparent.

5. A detector as claimed in claim 4, characterised in that the dimensions of the transparent electrode applied directly to the substrate surface are in at least one direction larger than the dimension of the detector film and of the second electrode applied to the detector film, and in that the transparent electrode has a metal contact in that region which protrudes beyond the detector film.

6. A detector as claimed in one of claims 1 to 5, characterised in that the detector film consists of amorphous silicon.

7. A detector as claimed in one of claims 1 to 5, characterised in that the detector film consists of a III-V-semiconductor.

8. A detector substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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